

What is claimed is:

1. A substrate processing apparatus, comprising:

5 a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and

a plating area for plating the substrate,

wherein the loading/unloading area is provided with a substrate transfer robot having a plurality of hands of dry-use design, a loading port for loading a cassette for housing
10 substrates, and a reversing machine of dry-use design for reversing the substrate from face up to face down.

2. A substrate processing apparatus, comprising:

15 a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and

a plating area for plating the substrate,

wherein the cleaning area is provided with a substrate
20 transfer robot having a hand of dry-use design, a hand of wet-use design and a hand of back surface attraction design, a pre-cleaning unit for cleaning the substrate before plating in the plating area, and a post-cleaning unit for cleaning the substrate after plating in the plating area.

25

3. The substrate processing apparatus according to claim 2, wherein the post-cleaning unit includes a roll brushing unit and a spin-drying unit.

4. The substrate processing apparatus according to claim 2, wherein the cleaning area is provided with:

5 a temporary substrate storage stage of dry-use design, having a lifting function, for temporarily storing the substrate during transfer of the substrate between the loading/unloading area and the cleaning area; and

a reversing machine of wet-use design for reversing the substrate, which has been transferred to the cleaning area after plating in the plating area, from face down to face up.

5. A substrate processing apparatus, comprising:

a loading/unloading area for carrying in and out a substrate;

15 a cleaning area for cleaning the substrate; and
a plating area for plating the substrate,

wherein the plating area is provided with a substrate transfer robot having a plurality of attracting hands for holding the substrate by attracting the back surface of the substrate, a first pretreatment unit for carrying out a catalyst-imparting treatment of the front surface of the substrate, a second pretreatment unit for carrying out a chemical liquid treatment of the front surface of the substrate after the catalyst-imparting treatment, and a plating unit for plating the substrate.

6. The substrate processing apparatus according to claim 5, wherein the plating unit is comprised of a plurality of units,

and the plating area is further provided with a plating solution supply unit for supplying a plating solution to the plurality of plating units.

5 7. A substrate processing apparatus, comprising:
a loading/unloading area for carrying in and out a substrate;
a cleaning area for cleaning the substrate; and
a plating area for plating the substrate,
10 wherein the cleaning area is provided with a pre-cleaning unit including a vessel housing a first treatment liquid spraying section for cleaning the substrate before plating in the plating area by bringing a first treatment liquid into contact with the substrate, a lid member for closing the opening of the vessel
15 after the substrate held in a substrate holding device is moved to above the opening, and a second treatment liquid spraying section mounted on the lid member for cleaning the substrate by bringing a second treatment liquid into contact with the substrate while the opening of the vessel is closed with the lid
20 member.

8. A substrate processing apparatus, comprising:
a loading/unloading area for carrying in and out a substrate;
25 a cleaning area for cleaning the substrate; and
a plating area for plating the substrate,
wherein the cleaning area is provided with a pre-cleaning unit for cleaning the substrate before plating, and a hand of

a substrate transfer robot disposed in the cleaning area and a hand of a substrate transfer robot disposed in the plating area are accessible to the pre-cleaning unit from the opposite sides for transferring the substrate.

5

9. A substrate processing apparatus, comprising:

a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and

10 a plating area for plating the substrate,

wherein the plating area is provided with a first pretreatment unit and a second pretreatment unit, each unit including a vessel housing a first treatment liquid spraying section for pretreating the substrate before plating by bringing
15 a first treatment liquid into contact with the substrate, a lid member for closing the opening of the vessel after the substrate held in a substrate holding device is moved to above the opening, and a second treatment liquid spraying section mounted on the lid member for cleaning the substrate by bringing a second
20 treatment liquid into contact with the substrate while the opening of the vessel is closed with the lid member.

10. A substrate processing apparatus, comprising:

a loading/unloading area for carrying in and out a
25 substrate;

a cleaning area for cleaning the substrate; and

a plating area for plating the substrate,

wherein the plating area is provided with a plating unit

including a processing tank for holding a plating solution, a lid member for closing the opening of the processing tank after the substrate held in a substrate holding device is moved to above the opening, and a treatment liquid spraying section mounted on the lid member for cleaning the substrate by bringing a cleaning liquid into contact with the substrate while the opening of the processing tank is closed with the lid member.

11. A substrate processing apparatus, comprising:
a loading/unloading area for carrying in and out a substrate;
a cleaning area for cleaning the substrate; and
a plating area for plating the substrate,
wherein the cleaning area is provided with a post-cleaning unit for cleaning the substrate after plating in the plating area, a pre-cleaning unit for cleaning the substrate before plating in the plating area, and a chemical liquid supply unit for supplying respective chemical liquids for cleaning to the pre-cleaning unit and to the post-cleaning unit.

12. The substrate processing apparatus according to claim 11, wherein the post-cleaning unit includes a roll brushing unit and a spin-drying unit.

13. A substrate processing apparatus, comprising:
a loading/unloading area for carrying in and out a substrate;
a cleaning area for cleaning the substrate; and

a plating area for plating the substrate,
wherein the plating area is provided with a first
pretreatment unit for pretreating the substrate before plating
by bringing a treatment liquid into contact with the substrate,
5 a second pretreatment unit for pretreating the substrate after
the pretreatment in the first treatment unit by bringing another
treatment liquid into contact with the substrate, and a chemical
liquid supply unit for supplying the respective chemical liquids
for treatment to the first pretreatment unit and to the second
10 pretreatment unit.

14. A substrate processing apparatus, comprising:
a loading/unloading area for carrying in and out a
substrate;
15 a cleaning area for cleaning the substrate; and
a plating area for plating the substrate,
wherein the loading/unloading area is provided with a
fixed-type substrate transfer robot not having a traveling
shaft.

20
15. A substrate processing apparatus, comprising:
a loading/unloading area for carrying in and out a
substrate;
a cleaning area for cleaning the substrate; and
25 a plating area for plating the substrate,
wherein the cleaning area is provided with a substrate
transfer robot having an arm mounted with a plurality of hands.

16. A substrate processing apparatus, comprising:
a loading/unloading area for carrying in and out a
substrate;

a cleaning area for cleaning the substrate; and
5 a plating area for plating the substrate,
wherein the cleaning area and/or the plating area is
provided with a substrate transfer robot having a back surface
attraction-type vacuum hand for holding and transferring the
substrate with its front surface facing downward.

10

17. A substrate processing apparatus, comprising:
a loading/unloading area for carrying in and out a
substrate;

a cleaning area for cleaning the substrate; and
15 a plating area for plating the substrate,
wherein the plating area is provided with a substrate
transfer robot having a vacuum hand, the vacuum hand including
a suction pad having a substrate attracting surface which is
retractable in the substrate attracting direction, and a fixed
20 member, disposed around the suction pad and having a flat
reference surface, for effecting positioning of the substrate
by retracting the suction pad to which the substrate is attracted
and thereby bringing the substrate into contact with the
reference surface.

25

18. A substrate processing apparatus, comprising:
a loading/unloading area for carrying in and out a
substrate;

a cleaning area for cleaning the substrate; and
a plating area for plating the substrate,

wherein the plating area is provided with a plurality of
plating units, each plating unit including a processing tank for
5 holding a plating solution, a lid member for closing the opening
of the processing tank after the substrate held in a substrate
holding device is moved to above the opening, and a treatment
liquid spraying section mounted on the lid member for cleaning
the substrate by bringing a cleaning liquid into contact with
10 the substrate while the opening of the processing tank is closed
with the lid member.

19. A substrate processing apparatus, comprising:

a loading/unloading area for carrying in and out a
15 substrate;

a cleaning area for cleaning the substrate; and
a plating area for plating the substrate,

wherein the cleaning area is provided with a pre-cleaning
unit for cleaning the substrate before plating in the plating
20 area, the plating area is provided with a pretreatment unit for
pretreating the substrate before plating by bringing a treatment
liquid into contact with the substrate, and the plating area is
provided with a plating unit for plating the pretreated substrate,
and a plurality of spray nozzles for spraying a liquid for
25 treatment or cleaning of a processing surface of the substrate
are mounted in at least one of said units, said spray nozzles
being disposed such that the liquid for treatment or cleaning
can be sprayed uniformly onto the entire processing surface of

the substrate.

20. A substrate processing apparatus, comprising:

5 a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and

a plating area provided with a processing tank for plating the substrate,

10 wherein the plating area is provided with a plating solution supply device including a plating solution circulation tank for storing a plating solution and circulating the plating solution between it and the processing tank, a heating section for heating the plating solution in the plating solution circulation tank, a thermometer for measuring the temperature
15 of the plating solution stored in the plating solution circulation tank, a thermometer for measuring the temperature of the plating solution in the processing tank, and a plating solution supply pump for controlling the circulation amount of the plating solution circulating between the plating solution
20 circulation tank and the processing tank so that the temperature of the plating solution in the processing tank becomes a suitable temperature for plating.

21. A substrate processing apparatus, comprising:

25 a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and

a plating area provided with a processing tank for plating

the substrate, and a plating solution circulation tank for storing a plating solution and circulating the plating solution between it and the processing tank,

wherein the plating solution circulation tank is provided
5 with a plating solution concentration diluting device for adjusting the concentration of the plating solution to a proper concentration.

22. A substrate processing apparatus, comprising:

10 a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and

a plating area provided with a plurality of plating units for plating the substrate,

15 wherein the plating area is provided with a plating solution supply device including a plurality of plating solution supply pumps each for supplying a plating solution to each of the plurality of plating units.

20 23. A substrate processing apparatus, comprising:

a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and

a plating area provided with a plating unit for plating
25 the substrate,

wherein the plating area is provided with a plating solution supply device for supplying a plating solution to the plating unit by a plating solution supply pump which is a vertical

centrifugal pump.

24. A substrate processing apparatus, comprising:

5 a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and

a plating area for plating the substrate,

10 wherein the plating area is provided with a plating unit for plating a processing surface of the substrate by bringing a plating solution into contact with the processing surface while the substrate is held in an attracting head and inserted in a processing tank, and

15 the attracting head is comprised of a base and a ring-shaped substrate attracting portion, mounted to the peripheral lower surface of the base, for attracting by vacuum the back surface of the substrate and functioning as a seal for preventing intrusion of the plating solution into the inside of the ring-shaped vacuum-attracted portion of the back surface of the substrate, and the base has openings for opening the space between
20 the substrate attracted to the substrate attracting portion and the base.

25 25. The substrate processing apparatus according to claim 24, wherein the plating unit is provided with a drive section for rotating the attracting head with the substrate vacuum-attracted at a high speed.

26. A substrate processing apparatus, comprising:

a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and

a plating area for plating the substrate,

5 wherein the plating area is provided with a plating unit for plating a processing surface of the substrate by bringing a plating solution into contact with the processing surface while the substrate is held in an attracting head and inserted in a processing tank, and

10 the attracting head includes a ring-shaped substrate attracting portion for attracting by vacuum the back surface of the substrate and functioning as a seal for preventing intrusion of the plating solution into the inside of the ring-shaped vacuum-attracted portion of the back surface of the substrate,
15 and the substrate attracting portion attracts a peripheral portion of the back surface of the substrate corresponding to a peripheral portion of the front surface in which no device is formed.

20 27. A substrate processing apparatus, comprising:

a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and

a plating area for plating the substrate,

25 wherein the plating area is provided with a plating unit for plating a processing surface of the substrate by bringing a plating solution into contact with the processing surface while the substrate is held in an attracting head and inserted in a

processing tank, and

the attracting head is provided with a substrate attracting portion having a substrate attracting groove connected to a vacuum supply line for attracting by vacuum the back surface of the substrate, and

the vacuum supply line, besides vacuuming, is capable of supplying an inert gas and/or a cleaning liquid and a cleaning spray nozzle is disposed in the vicinity of the substrate attracting portion,

wherein the outside of the substrate attracting portion is cleaned by the cleaning spray nozzle while the interior of the vacuum supply line and the substrate attracting groove is cleaned by supplying the inert gas or the cleaning liquid from the vacuum supply line to the substrate attracting groove.

15

28. A substrate processing apparatus, comprising:

a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and

20 a plating area for plating the substrate,

wherein the plating area is provided with a plating unit for plating a processing surface of the substrate by bringing a plating solution into contact with the processing surface while the substrate is inserted in a processing tank, and

25 a spray nozzle for spraying a cleaning liquid onto the surface of the substrate after plating is provided in the processing tank of the plating unit.

29. A substrate processing apparatus, comprising:
a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and
5 a plating area for plating the substrate,

wherein the cleaning area is provided with a pre-cleaning unit for housing in a vessel the substrate before plating in the plating area and cleaning the substrate, and

the plating area is provided with a pretreatment unit for
10 housing in a vessel the substrate cleaned in the pre-cleaning unit and pretreating the substrate,

wherein a spray nozzle for internal cleaning of vessel is provided within the vessel of the pre-cleaning unit and/or within the vessel of the pretreatment unit.

15

30. A substrate processing apparatus, comprising:

a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and
20 a plating area provided with a processing tank for plating the substrate,

wherein the plating area is provided with a plating solution circulation tank for supplying a plating solution to the processing tank and circulating the plating solution, and
25 the plating solution circulation tank is provided with an indirect heating section for circulating a heated fluid as a heat medium within a tube to thereby heat the plating solution in an indirect manner.

31. A substrate processing apparatus, comprising:

a loading/unloading area for carrying in and out a substrate;

5 a cleaning area for cleaning the substrate; and

a plating area provided with a processing tank for plating the substrate,

wherein the plating area is provided with a plating solution circulation tank for supplying a plating solution to the processing tank and circulating the plating solution, and
10 the plating solution circulation tank has a double or multiple structure.

32. A substrate processing apparatus, comprising:

15 a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and

a plating area provided with a processing tank for plating the substrate,

20 wherein the processing tank is equipped with a thermometer for measuring the temperature of a plating solution in the processing tank.

33. A substrate processing apparatus, comprising:

25 a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and

a plating area for plating the substrate,

wherein the plating area is provided with a pretreatment unit for pretreating the substrate before plating by bringing a treatment liquid into contact with the substrate, said pretreatment unit, including;

5 a processing tank for holding a plating solution,

a lid member for closing the opening of the processing tank after the substrate held in a substrate holding head is moved to above the opening, and

10 a treatment liquid spraying section mounted on the lid member for spraying a cleaning liquid onto the substrate to clean the substrate while the opening of the processing tank is closed with the lid member, said substrate fixing head being provided with a tilting mechanism.

15 34. A substrate processing apparatus, comprising:

a loading/unloading area for carrying in and out a substrate;

a cleaning area for cleaning the substrate; and

20 a plating area provided with a processing tank for plating the substrate,

wherein the plating area is provided with a plating solution circulation tank for supplying a plating solution to the processing tank and circulating the plating solution, and

25 a gas bubble dissolution preventing section which, when the plating solution flows into the plating solution circulation tank, prevents gas bubbles from dissolving into the plating solution is provided in a pipe for circulating the plating solution from the processing tank to the plating solution

circulation tank.

35. A substrate processing apparatus, comprising:

a loading/unloading area for carrying in and out a
5 substrate;

a cleaning area for cleaning the substrate; and

a plating area for plating the substrate,

wherein a sample port for taking a predetermined amount
of liquid sample is provided in at least one of a supply line
10 for a cleaning liquid for use in a pre-cleaning unit, disposed
in the cleaning area, for cleaning the substrate before plating
in the plating area by bringing the cleaning liquid into contact
with the substrate, a supply line for a treatment liquid for use
in a pretreatment unit, disposed in the plating area, for
15 pretreating the substrate before plating by bringing the
treatment liquid into contact with the substrate, and a supply
line for a plating solution for use in a plating unit, disposed
in the plating area, for plating the pretreated substrate by
bringing the plating solution into contact with the substrate,
20 and

a liquid replenishment section for supplying an amount of
liquid corresponding to the amount taken as a sample to at least
one of the pre-cleaning unit, the pretreatment unit and the
plating unit is provided.

25

36. A substrate processing apparatus, comprising:

a loading/unloading area for carrying in and out a
substrate;

a cleaning area for cleaning the substrate; and

a plating area for plating the substrate,

wherein a plurality of filters are provided in series in
at least one of a supply line for a cleaning liquid for use in
5 a pre-cleaning unit, disposed in the cleaning area, for cleaning
the substrate before plating in the plating area by bringing the
cleaning liquid into contact with the substrate, a supply line
for a treatment liquid for use in a pretreatment unit, disposed
in the plating area, for pretreating the substrate before plating
10 by bringing the treatment liquid into contact with the substrate,
and a supply line for a plating solution for use in a plating
unit, disposed in the plating area, for plating the pretreated
substrate by bringing the plating solution into contact with the
substrate.

15

37. A substrate processing method, comprising:

carrying out a cleaning treatment and a catalyst-imparting
treatment as pre-plating treatments before electroless plating
of the surface of a substrate,

20 wherein the cleaning treatment is carried out in a wider
area of the substrate surface than that area to which a catalyst
is imparted by the catalyst-imparting treatment.

38. The substrate processing method according to claim 37,
25 wherein the area of the substrate surface to which a catalyst
is imparted by the catalyst-imparting treatment is the same as
that area for which uniform plating is necessary.

39. The substrate processing method according to claim 37, wherein the cleaning treatment as a pre-plating treatment comprises pre-cleaning prior to the catalyst-imparting treatment and cleaning after the catalyst-imparting treatment.

5

40. A substrate processing apparatus, comprising:

a cleaning treatment unit for carrying out a cleaning treatment of a substrate; and

a catalyst-imparting treatment unit for carrying out a catalyst-imparting treatment of the substrate, said respective treatment being carried out as a pre-plating treatment by allowing the surface of the substrate to be in contact with a respective pre-plating treatment liquid while sealing a peripheral portion of the substrate surface with a seal ring,

15 wherein the cleaning treatment unit is designed to carry out the cleaning treatment in a wider area of the substrate surface than that area to which a catalyst is imparted in the catalyst-imparting treatment unit.

20 41. The substrate processing apparatus according to claim 40, wherein the area of the substrate surface to which a catalyst is imparted in the catalyst-imparting treatment unit is the same as that area for which uniform plating is necessary.

25 42. The substrate processing apparatus according to claim 40, wherein the cleaning treatment unit and the catalyst-imparting treatment unit have the same construction except that the seal rings have different opening areas.

43. A substrate processing method, comprising:

dipping a substrate in a horizontal position into a processing liquid to thereby bring the processing liquid into
5 contact with a processing surface of the lower surface of the substrate; and

creating a flow of the processing liquid flowing along the processing surface from the center toward the periphery so that gas bubbles remaining on the processing surface are removed by
10 the flow of the processing liquid.

44. The substrate processing method according to claim 43, wherein a circular slit is formed in the vicinity of the periphery of the processing surface of the substrate, and the processing
15 liquid, which has flowed from below the processing surface of the substrate to the processing surface and flows along the processing surface, is allowed to pass through the slit, thereby increasing the flow speed of the flow of the processing liquid along the processing surface and removing gas bubbles on the
20 processing surface.

45. A substrate processing apparatus, comprising:

a processing tank for holding a processing liquid; and
a substrate holding device for holding a substrate on the
25 lower surface and dipping the substrate held in a horizontal position into the processing liquid,

wherein the processing tank is provided with a gas bubble removing section which, when a processing surface of the

substrate lower surface held in the substrate holding device is in contact with the processing liquid, allows the processing liquid over the processing surface to flow from the center of the substrate toward the periphery.

5

46. The substrate processing apparatus according to claim 45, wherein the gas bubble removing section is comprised of a circular top end portion which is provided in the processing tank so that a circular slit is formed in the vicinity of the periphery
10 of the processing surface of the substrate dipped in the processing liquid.

47. The substrate processing apparatus according to claim 46, wherein the top end portion is the top end portion of a second
15 tank disposed inside the peripheral portion of the processing tank such that the second tank, together with the peripheral portion of the processing tank, constitutes a double structure, or the top end portion of the peripheral portion of the processing tank.

20

48. The substrate processing apparatus according to claim 47, wherein a recovery groove for recovering the processing liquid overflowing the top end of the processing tank is provided around the peripheral portion of the processing tank.

25

49. The substrate processing apparatus according to claim 45, wherein an escape groove for passing therethrough the processing liquid flowing along the substrate from the center

toward the periphery is provided at the bottom of the substrate holding device and around the substrate held.

50. A substrate processing apparatus, comprising:

5 a processing tank for holding a processing liquid;
 a substrate holding device for holding a substrate; and
 a substrate holding device drive section for tilting a
processing surface of the substrate held in the substrate holding
device and bringing the processing surface into contact with the
10 processing liquid to carry out processing while the processing
surface is kept tilted.

51. The substrate processing apparatus according to claim
50, wherein the processing of the processing surface of the
15 substrate with the treatment liquid is a pre-plating treatment.

52. The substrate processing apparatus according to claim
50, wherein the substrate holding device drive section is
provided with a substrate-liquid contact region adjusting
20 section for adjusting the region of the processing surface of
the substrate to be in contact with the processing liquid within
the range of 0-100% of the whole processing surface.

53. The substrate processing apparatus according to claim
25 50, wherein the substrate processing apparatus further comprises
a suction section which, when the substrate in a tilted position
is in contact with the processing liquid, sucks air which has
collected between the processing surface of the substrate and

the processing liquid so as to forcibly discharge the air.

54. The substrate processing apparatus according to claim 50, wherein the substrate processing apparatus further comprises
5 a processing liquid supply section for creating a flow of the processing liquid along the tilted processing surface of the substrate in contact with the processing liquid, flowing from the deeper side to the shallower side.

10 55. The substrate processing apparatus according to claim 50, wherein an escape groove which, when the substrate is in contact with the processing liquid, escapes air which has collected under the lower surface of the substrate is provided at the bottom of the substrate holding device and around the
15 substrate held.

56. A substrate processing method, comprising:

processing a substrate by allowing a processing surface of the substrate to be in contact with a processing liquid while
20 the processing surface is kept tilted.

57. The substrate processing method according to claim 56, wherein the processing is carried out by allowing part of the processing surface of the substrate to be in contact with the
25 processing liquid while rotating the substrate in a tilted position.

58. The substrate processing method according to claim 56,

wherein the processing of the processing surface of the substrate with the treatment liquid is a pre-plating treatment.

59. The substrate processing method according to claim 56,
5 wherein the substrate processing method further comprises forcibly discharging by suction air which has collected between the processing surface of the substrate and the processing liquid.

10 60. The substrate processing method according to claim 56, wherein the substrate processing method further comprises creating a flow of the processing liquid along the tilted processing surface of the substrate in contact with the processing liquid, flowing from the deeper side to the shallower
15 side.

61. A substrate processing apparatus, comprising:
a processing tank for holding a processing liquid;
a substrate holding device for holding a substrate;
20 a substrate holding device drive section for tilting a processing surface of the substrate held in the substrate holding device and bringing the processing surface into contact with the processing liquid while the processing surface is kept tilted, and then bringing the processing surface to a horizontal position
25 to carry out processing; and

a suction section which, while the substrate in a tilted position in contact with the processing liquid is brought to the horizontal position, sucks air which has collected between the

processing surface of the substrate and the processing liquid so as to forcibly discharge the air.

62. A substrate processing apparatus, comprising:

5 a processing tank for holding a processing liquid;
 a substrate holding device for holding a substrate;
 a substrate holding device drive section for tilting a processing surface of the substrate held in the substrate holding device and bringing the processing surface into contact with the processing liquid while the processing surface is kept tilted,
10 and then bringing the processing surface to a horizontal position to carry out processing; and

 a processing liquid supply section which, while the substrate in a tilted position in contact with the processing liquid is brought to the horizontal position, creates a flow of
15 the processing liquid along the tilted processing surface of the substrate, flowing from the deeper side to the shallower side.

63. A substrate processing apparatus, comprising:

20 a processing tank for holding a processing liquid;
 a substrate holding device for holding a substrate; and
 a substrate holding device drive section for tilting a processing surface of the substrate held in the substrate holding device and bringing the processing surface into contact with the processing liquid while the processing surface is kept tilted,
25 and then bringing the processing surface to a horizontal position to carry out processing,

 wherein an escape groove which, while the substrate in a

tilted position in contact with the processing liquid is brought to the horizontal position, escapes air which has collected between the processing surface of the substrate and the processing liquid is provided at the bottom of the substrate
5 holding device and around the substrate held.

64. A substrate processing method, comprising:

bringing a processing surface of a substrate in a tilted position into contact with a processing liquid and then bringing
10 the processing surface to a horizontal position to carry out processing of the surface; and

forcibly discharging by suction air which has collected between the processing surface of the substrate and the processing liquid when bringing the tilted substrate in contact
15 with the processing liquid to the horizontal position.

65. A substrate processing method, comprising:

bringing a processing surface of a substrate in a tilted position into contact with a processing liquid and then bringing
20 the processing surface to a horizontal position to carry out processing of the surface; and

creating a flow of the processing liquid along the tilted processing surface of the substrate, flowing from the deeper side to the shallower side, when bringing the tilted substrate in
25 contact with the processing liquid to the horizontal position, thereby removing gas bubbles on the processing surface of the substrate.

66. A substrate holding device for holding a substrate by attracting the back surface of the substrate to the lower surface of an attracting head, comprising:

5 a ring-shaped substrate attracting portion for attracting by vacuum the back surface of the substrate and functioning as a seal for preventing intrusion of a processing liquid into the inside of the ring-shaped vacuum-attracted portion of the back surface of the substrate; and

10 a pusher for pressing on the substrate attracted to the substrate attracting portion in a direction away from the attracting head, said substrate attracting portion and said pusher being mounted in a peripheral region of the lower surface of the attracting head.

15 67. The substrate holding device according to claim 66, wherein the pusher is connected to a vacuum supply line so that the pusher retracts into the attracting head by vacuuming through the vacuum supply line, while the pusher protrudes from the attracting head by a supply of a gas to the vacuum supply line
20 to press on the back surface of the substrate held in the attracting head.

68. The substrate holding device according to claim 67, the pusher retracted in the attracting head does not make contact
25 with the back surface of the substrate attracted and held on the lower surface of the attracting head.

69. The substrate holding device according to claim 67,

wherein the vacuum supply line, besides connection to the pusher, is also connected to the substrate attracting portion.

70. A substrate processing apparatus, comprising:

5 a substrate holding device for holding a substrate by attracting the back surface of the substrate to the lower surface of an attracting head; said substrate holding device including a ring-shaped substrate attracting portion for attracting by vacuum the back surface of the substrate and functioning as a seal for preventing intrusion of a processing liquid into the inside of the ring-shaped vacuum-attracted portion of the back surface of the substrate, and a pusher for pressing on the substrate attracted to the substrate attracting portion in a direction away from the attracting head, said substrate attracting portion and said pusher being mounted in a peripheral region of the lower surface of the attracting head; and

10

15

 a substrate processing section for carrying out processing of a processing surface of the substrate held in the substrate holding device with the processing liquid.

20

71. A method for attaching/detaching a substrate to and from a substrate holding device, comprising:

 attracting and releasing the back surface of the substrate to and from the lower surface of an attracting head of the substrate holding device,

25

 wherein the attraction of the substrate to the lower surface of the attracting head is carried out by attracting by vacuum and sealing the back surface of the substrate with a

ring-shaped attracting and sealing portion, while the release of the substrate from the lower surface of the attracting head is carried out by emitting a gas from the ring-shaped vacuum-attracting portion and pressing on a portion of the back
5 surface of the substrate positioned inside the ring-shaped vacuum-attracting portion by a pusher.